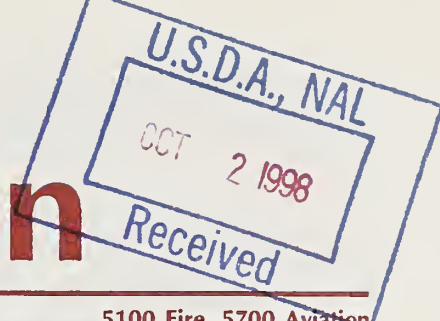


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Fire & Aviation



USDA Forest Service

• Technology & Development Program •

5100 Fire, 5700 Aviation



The Fire and Aviation Program of the Missoula Technology and Development Center (MTDC) has, for almost forty years, engaged in equipment design, development, and information transfer to users. These services are designed, in conjunction with technical support, to ensure that technology provides a safe and efficient work environment in fire management activities. The Program Leader is Dick Mangan. This report summarizes current work in MTDC projects and lists recent publications, audiovisuals, and drawings.

Technical Services— Fire & Aviation Management

TE02P16

Dick Mangan is the Program Leader

One of the most frequently used services provided by MTDC is technical support. Our commitment is not only to program development, but to the support of existing programs and products. MTDC can provide information about existing equipment and programs that are in development as well as provide subject-area specialists as speakers for training sessions and conferences. The expertise available is broad-based and

covers everything from personal protective equipment to smokejumper aircraft.

MTDC must remain abreast of new technology and issues of importance in the realm of fire and aviation because MTDC personnel represent the Forest Service or serve as advisors on a variety of committees and task groups such as the Fire Equipment Working Team (FEWT), the Fireline Safety Committee, the National Fire Equipment Systems Committee (NFES), the Fireline Explosives Working Team, regional and area fire equipment committees, the National Fire Protection Association (NFPA) Committees,



Members of the MTDC Fire & Aviation Program team.

and the Smokejumper Aircraft Screening and Evaluation Board (SASEB).

In a continuing effort to disseminate information, technical specialists in the Fire and Aviation Management Program at MTDC are constantly in contact with field personnel through mail, telephone, and electronic mail to answer questions and to evaluate new concepts. Examples of work currently underway in this project are:

Wildland Firefighter Protective Clothing & Equipment

Dick Mangan is the Project Leader

For the first time, the National Fire Protection Assoc. (NFPA) is addressing protective clothing standards for wildland firefighters. This effort includes representatives from the USDA Forest Service, other federal and state agencies, manufacturing groups, union representatives, and enforcement entities such as the Occupational Safety & Health Administration (OSHA). The NFPA Subcommittee on Wildland Firefighter Clothing and Equipment has been divided into three task groups with an MTDC representative active in each area: Dr. Ted Putnam, who works with fire shelters and firefighters' protective clothing; Dick Mangan, who works with boots, gloves, and hard hats; and Dr. Brian Sharkey, who is working on a respirator standard. Standards for this equipment are planned for public comment by August of 1992, with possible implementation by August of 1993.

Bladders for Potable and Nonpotable Water

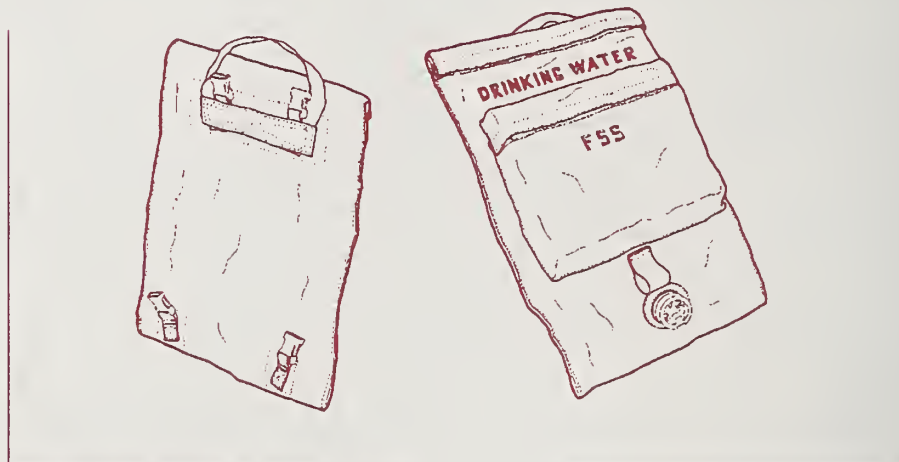
Dr. Ted Putnam is the Project Leader

MTDC has developed a series of potable and nonpotable water bladders to ensure that a convenient, cost efficient, and portable method of delivering water to firefighters is available. All of the bladders are made of coated nylon duck and are color-coded—blue for potable and yellow for nonpotable water. These bladders feature replaceable, recyclable plastic liners. The liners for the potable water bladders meet Food & Drug Administration (FDA)

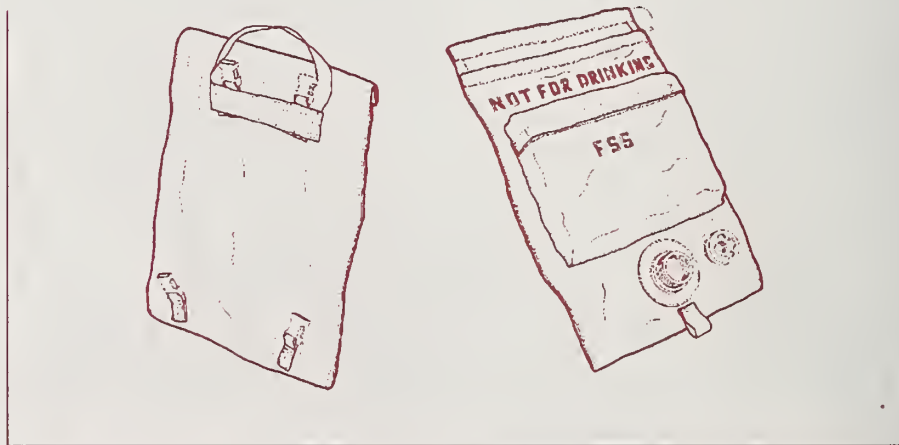
standards for use with drinking water. One-gallon and five-gallon potable water bladders are available through the General Services Administration (GSA).

A newly designed 5-gallon backpack pump became available through the GSA catalog in 1991. It features more heavily padded shoulder straps and a better distribution of weight than older designs.

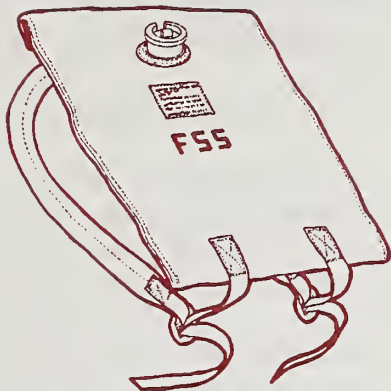
New 55-gallon potable and nonpotable bladders have also been developed. They are similar in construction to the smaller bladders and can be



5-gallon water bag used for potable water.



5-gallon fabric tank used for nonpotable water.



1-gallon water bag used for potable water.

transported by helicopter or vehicle. Weight limitations are a critical safety consideration in helicopter operations. The new 55-gallon bladder has been designed in conjunction with the weight limitations of "light" or type III helicopters to ensure that the carrying-capacity of the helicopter is not exceeded. The bladder will be available from GSA for use in the 1993 field season.

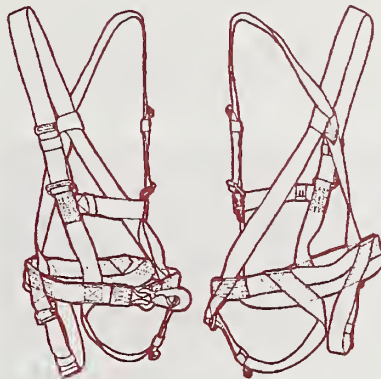
The bladders were designed by George Jackson, MTDC Equipment Specialist. A **Tech Tips** will be published describing the bladders in greater detail.

Helicopter Rappel Harness

George Jackson is the Project Leader

MTDC has developed a full-body rappel harness for the USDA Forest Service Helicopter Rappel Program. Forty-five prototype harnesses were sent to rappel bases in the Southwestern, Intermountain, and Pacific Northwest Regions for field evaluation during the 1991 fire

season. The final design has been completed and technical drawings are being produced. George Jackson is the designer.



Heli-rappel harness, Model HR-1.

Single Unit Headlamp

Dave Gasvoda is the Project Leader

The headlamps used for night fireline activities have been cumbersome and have provided poor illumination. This has proved to be both an annoyance and a safety concern. MTDC is constantly searching for an improved headlamp and power source that are lightweight and provide a strong, long-lasting beam. MTDC has experimented with different reflectors, power sources, and methods for regulating current flow. MTDC Electronic Engineer, Dave Gasvoda, has recently been granted a patent for a device that regulates the luminous flux on firefighters' headlamps. This device regulates current flow and helps ensure a constant level of illumination.

In the past, the performance of the alkaline batteries used has affected headlamp performance;

however, new manufacturing techniques have improved the power and longevity of the alkaline cells. In addition, Litheon batteries, which provide greater performance and weigh less, are being tested for headlamp use. Previous versions of the Lithium batteries were deemed to be unsafe for use in aviation-related activities. However, recent changes in design have produced a battery that is safe and complies with Department of Transportation regulations. Although Litheon cells are not cost-effective at this time, they are expected to provide a safe and powerful source of energy in the future.

Results will be published in a **Tech Tip**.

Fireline Explosives

Jim Tour is the Project Leader

MTDC has been designated by the Forest Service as the responsible unit for the certification of fireline explosives. In this capacity, the NWCG Fireline Explosives Subcommittee utilizes the MTDC staff specialist as a technical advisor. A series of tests is conducted by MTDC and the Bureau of Mines before fireline explosives are approved for use. Tests include the stability of the active explosive component of a product and field tests of the product itself.

A new Exploding Bridge Wire Detonator (model RP-501) has also been introduced. The previously introduced RP-80 and the RP-501 are identical except

that the RP-80 has an o-ring moisture barrier. The exclusion of the o-ring makes the RP-501 much more economical and an excellent choice for explosives work in dry conditions.

A new battery design for the EBW firing system has also been

approved. This system utilizes five nine-volt batteries, which are more readily available commercially than the presently used 45-volt rechargeable battery.

Two **Tech Tips** have been published documenting this work.



Preparing fireline explosives for line construction.

Firefighters' Personal Tent

0E02P28

Dr. Ted Putnam is the Project Leader

Attempts are being made to reduce smoke exposure and to provide a healthier resting environment for firefighters. An excellent way to accomplish this is through the development of a personal tent. Initial tests have shown a significant reduction in smoke exposure when the tents are used. In addition, because the tents protect from cold air, moisture, excessive dust, and insects, they provide a cleaner microenvironment and better rest when firefighters are off-shift. The current prototype is semi-freestanding, has a 42-inch interior height, 35 square feet of floor space, and weighs approximately 7.5 pounds. Seventy-eight tents were distributed to fire crews for testing during the 1991 fire season. Modifications are being made based on comments from the field evaluations. The tent should be available through GSA for the 1993 field season. A **Tech Tip** will describe work done in this project. George Jackson is the designer.

Firefighter Head and Neck Protection

0E92P29

Dr. Ted Putnam is the Project Leader

MTDC has studied the need for face and neck protection among wildland firefighters. An analysis has been conducted to determine the advantages and disadvantages of such protection. A market search was conducted to identify commercially available protectors and field units were contacted to determine what types of protective equipment are currently used. In addition, treadmill studies have been conducted to measure the affects of the equipment on work performance and heat stress. MTDC has recommended that a prototype be developed that can be integrated into the hardhats used by wildland firefighters.

Fire Shelter Improvements

7E72P17

Dr. Ted Putnam is the Project Leader

The fire shelter remains an essential safety item for line firefighters and is continuously evaluated to insure its effectiveness. MTDC has been involved in investigations of deployments including the Dude, the Wasatch Mountain, and the California Fires in 1990. Deployments are carefully investigated to provide information for fire shelter design improvements. A study of the adhesive used in the construction of fire shelters is being conducted in an attempt to find an adhesive that raises the delamination temperature. In 1993, the actual design of the fire shelter will be

studied to determine if a safer shelter can be constructed.

Your Fire Shelter: Beyond the Basics-1991 and the pamphlet *Your Fire Shelter 1991* were updated to incorporate the lessons learned from the fireline fatalities of 1990. These publications help supervisors and instructors increase their knowledge of fire shelter procedures and serve as training guides. A fire shelter designed specifically for training has been developed by the California Department of Forestry. This representation of a fire shelter will provide a less costly device for completing crucial hands-on training. Technical drawings for this project are being completed by MTDC, and the shelter will be ready for use in 1993 training sessions.



Proper deployment of the existing forest fire shelter.

Ground Ignition

1E12P80

Jim Tour is the Project Leader

A comprehensive guide to ground firing devices is being produced by MTDC. This publication will consolidate ground ignition devices into a single volume and will include a limited discussion of their advantages and disadvantages. A review draft has been produced, with the final document expected by the end of 1992.

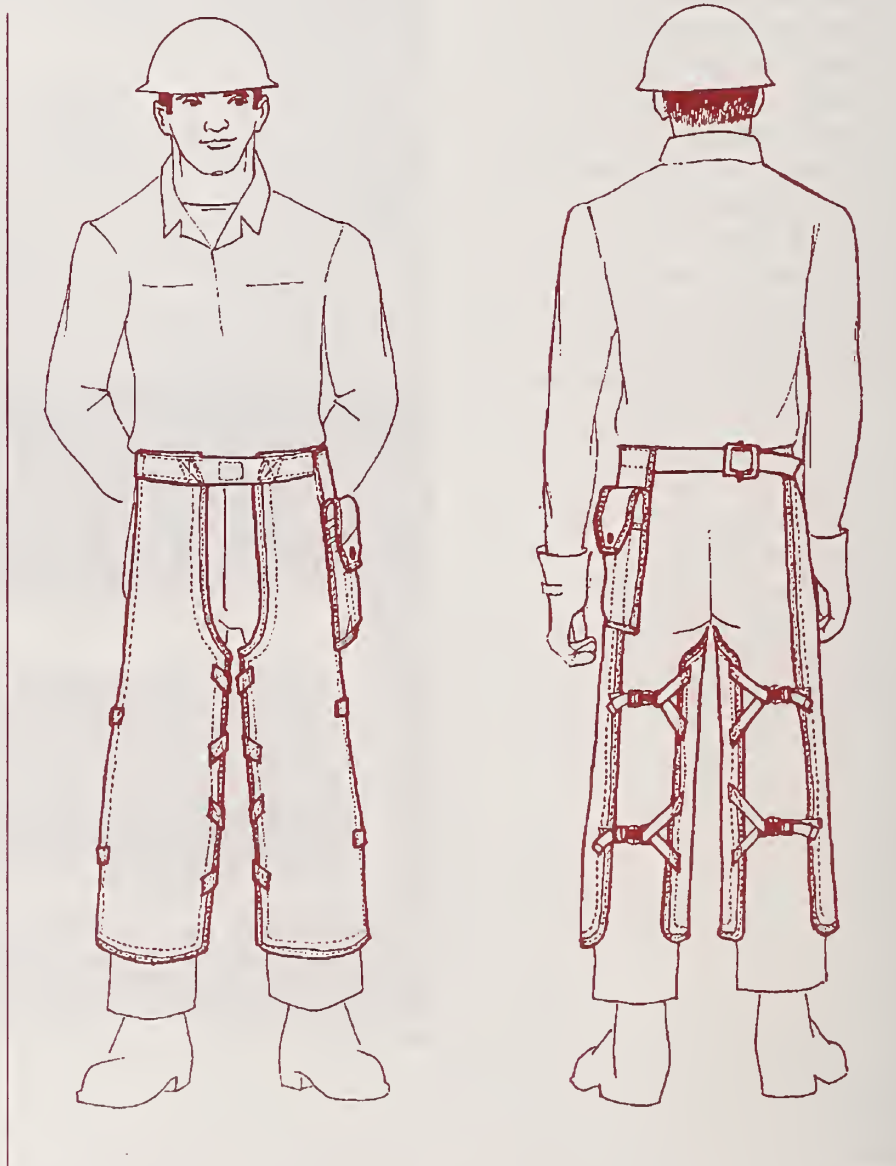
Chainsaw Chaps

TE02P24

George Jackson is the APA and ASTM representative.

The USDA Forest Service has long been the world leader in the development and evaluation of personal protective equipment for chainsaw users. MTDC personnel have been involved with the American Pulpwood Association (APA) in writing a test method for acceptance by

the American Society for Testing and Materials (ASTM) to establish a standard for minimum levels of protection when using a chainsaw. A document stating minimum levels of protection was approved by the full ASTM society in January of 1992. These guidelines will cover workers under OSHA jurisdiction and will have far-reaching effects. Chainsaw chaps are available from GSA.



Chainsaw chaps with new method of attachment.

Aircraft Accessories

3E22P40

Dave Pierce is the Project Leader

In addition to the design and fabrication of Sherpa accessories, MTDC has recently completed constructing twelve Twin-Otter horizontal anchor bracket kits and plates. MTDC is completing work on a reconfiguration of the primary and secondary anchor cables for the turbine DC-3's operated by the Northern and Intermountain Regions. The configuration of the new primary static-line anchor for the DC-3 will eliminate canopy/tail wheel strikes and remove the need for a static-line extender required in the old design.

Final design and FAA supplemental type certificates (STC) pull test of primary and secondary anchor cables for the Dornier 228, used by BLM-Alaska, have been completed. MTDC also fabricated and provided a complete set of anchor cables and handrails to adapt the Intermountain Region's new Twin Otter for smokejumper missions. The design and fabrication of accessories for the Cessna 208 Caravan is complete and work to reconfigure the accessories for the Beech 99 aircraft to allow use by BLM Ram-air smokejumpers has been accomplished. Dick Karsky and Deb O' Rourke are the design engineers.

Aerial Ignition

4E42P14

Jim Tour is the Project Leader

MTDC serves as technical advisor and as a source of product information for the aerial ignition program. Technical experts provide information to ensure that aerial ignition devices are used correctly and that the program moves toward safer and more efficient systems. This includes advice concerning the performance of ignition devices and the fuels used for ignition. MTDC specialists are involved in sponsoring the *Helicopter Operations Specialists Workshop* and serve as technical advisors for field evaluations of equipment and technology and as advisors for actual burning operations.

A **Tech Tip** describing a safe helitorch pump has been published.



Helitorch in a prescribed burn operation.



Supplemental type certificates (STC) test on static-line anchor cable in smokejumper aircraft.

Health Hazards of Smoke

9E92P13

Dr. Brian Sharkey is the Project Leader

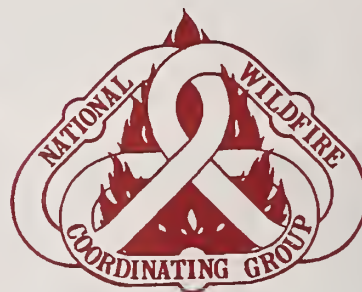
The National Wildfire Coordinating Group (NWCG) has assigned MTDC the task of coordinating ongoing and future

studies of the effects of forest fire smoke on firefighters. Forest fire smoke contains respirable particles, organic vapors, and carbon monoxide. All three of these substances are potentially dangerous; however, current research is insufficient to determine if fireline protection from all three substances is needed.

A multi-agency technical panel was recently convened to review existing research and identify research needs and priorities. Recent research includes a National Institute of Occupational Safety and Health (NIOSH) sponsored study of fireline exposure and health effects; a study of the health effects of smoke exposure being conducted by the California Occupational Health Program; smoke exposure at prescribed burns being studied by the Pacific Northwest Research Lab in cooperation with the University of Washington Department of Environmental Health and the Radian Company; and a study of smoke exposure during initial attack, involving the Lawrence Livermore National Laboratory and the California Department of Forestry (CDF). For a more thorough discussion of research being done in this area, *Health Hazards of Smoke*, is available from MTDC.



Graduate students in exercise science conduct a test in the University of Montana Human Performance Laboratory. (Photo, Randall Green)



Smoke Respirators

0E02P30

Dr. Brian Sharkey is the Project Leader

MTDC is evaluating the use of respirators by wildland firefighters. Work in this area includes a market search to ascertain the availability of respirators; tests of respirator function and user acceptance; studies of the respirators' effect on firefighter work capacity; and a search for a test or tests that will predict the ability of firefighters to work while wearing a respirator. If respirators are recommended for wildfire and/or prescribed fire use, MTDC will develop a training program and help implement their use Servicewide.



Respirator in use on a prescribed burn.

Flail Trencher

2E22P38

Keith Windell is the Project Leader

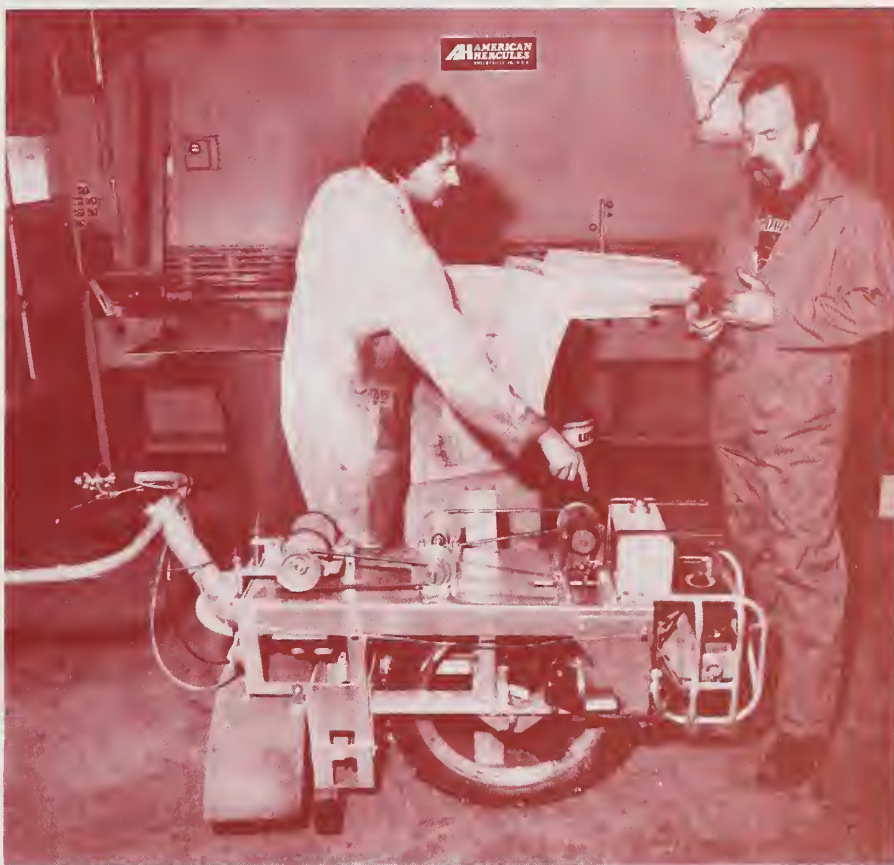
More than two thirds of the firefighters responding to an MTDC survey felt there is a need to fill the equipment gap between fire handtools and bulldozers. Responses indicate that the trencher is needed to construct control lines for both wildfires and prescribed burning operations.

The major needs for prescribed burning exist because: (1) Cost of constructing control lines for

prescribed burning is too high; and (2) Hiring constraints and other factors make it more difficult to obtain hand labor to accomplish the job.

Design and performance were compared between the "brush-cutter" power unit and the "wheelbarrow" concepts.

Currently, an aluminum framed, 2-cycle version, which weighs 150 pounds and incorporates studded tires for increased traction, is being developed and will be field-tested during the 1992 field season.



Two-cycle aluminum prototype trencher in the MTDC shop.

Dozer/Plow Safety

1E12P77

Jerry Jeffries is the Project Leader

The dozer/plow is, in many parts of the United States, a primary suppression tool. Although very effective, these operations are hazardous; serious injuries and fatalities occur almost every year. A nationwide review of accidents

and fatalities has been conducted. The review focused on strategy and tactics, and on the types and effectiveness of equipment, communications, and personal protective equipment being used.

A field evaluation of dozer operations in the Pacific Southwest Region was

completed during the 1991 field season. Personnel from the California Department of Forestry, the Los Angeles and Ventura County Fire Departments, and the USDA Forest Service were surveyed to gather information on safety procedures and concerns.

Attention was also given to the problems encountered during fire plow operations in the Southeastern United States, particularly in Florida and North Carolina. Unique communications and safety problems are encountered there due to the density of the vegetation and the flat terrain.

The tremendous variance in techniques and equipment causes a variety of safety concerns to arise. The survey of dozer/plow operations has helped provide a greater understanding of these concerns. These safety concerns will now be addressed in several ways by MTDC. A training package will be developed that will focus on the identified safety concerns, and improved communications capabilities will be investigated to better serve the needs and special conditions in which dozer/plows must function.



Constructing fire line with a dozer plow.

Publications

Your Fire Shelter: A Facilitator Discussion Guide—1991, Putnam, April 1991, 9151-2822-MTDC.

Requirements and Procedures for Fireline Explosive Products, Pierce, November 1990, 9151-2804-MTDC.

Comparing FS-12 and BLM Ram-Air Smokejumper Parachutes, Pierce, May 1990, 9051-2808-MTDC.

A Study of Wildland Firefighting Work/Rest Cycles, Jukkala and Sharkey, October 1988, 8951-2235-MTDC.

Parachute Maneuvering Simulator, Pierce, November 1990, 9151-2803-MTDC.

An Improved Wildland Firefighting Handtool, Jukkala and Sharkey, April 1988, 8851-2802-MTDC.

Fitness and Work Capacity Testing, Pamphlet, Jukkala and Sharkey, July 1977, 7751-25-11-MTDC.

Heat Stress, Pamphlet, Sharkey, July 1977, 7951-2505-MTDC.

Fit To Work, Pamphlet, Sharkey, July 1985, 8851-2501-MTDC.

Muscular Fitness Tests—Validation, Sharkey and Jukkala, April 1980, 8051-2203-MTDC.

Muscular Fitness Tests—Development & Evaluation, Sharkey and Jukkala, February 1980, 8051-2201-MTDC.

Combi Tool, Pamphlet, Jukkala, March 1989, 8951-2809-MTDC.

Health Hazards of Smoke, Sharkey, August 1990, 9067-2826-MTDC.

Health Hazards of Smoke, Sharkey, February 1991, 9167-2809-MTDC.

Health Hazards of Smoke, Sharkey, September 1991, 9167-2848-MTDC.

Health Hazards of Smoke, Sharkey, April 1992, 9267-2824-MTDC.

New Waterbag and Improved Canteen, **Tech Tips**, Jukkala, August 1988, 8551-2203-MTDC.

The Combi—A New Firefighting Handtool, **Tech Tips**, Jukkala, February 1988, 8851-2303-MTDC.

Improved Firefighters' Field Pack, **Tech Tips**, Jukkala, April 1988, 8851-2305-MTDC.

Shinguards for Forest Workers, **Tech Tips**, Putnam, February 1988, 8851-2304-MTDC.

Lightweight Crosscut Saws, **Tech Tips**, Pierce, April 1989, 8951-2312-MTDC.

Safe Helitorch Pump, **Tech Tips**, Tour, December 1990, 9151-2307-MTDC.

New Exploding Bridgewire Detonator, **Tech Tips**, Tour, August 1991, 9151-2331-MTDC.

New Fireline Explosives, **Tech Tips**, Tour, August 1991, 9151-2330-MTDC.

Fire Entrapment Video Available, **Tech Tips**, Ault, April 1992, 9251-2325-MTDC.

Drawings

MTDC-776—Battery for Headlamp
MTDC-778—Argosy Anchor Cable
MTDC-785—Beech 99 Step
MTDC-791—Cessna 208 Anchor Cable

MTDC-793—Simula Adapter, Otter

MTDC-794—Universal Step Strut

MTDC-799—Volpar Step

MTDC-804—Cessna 208 Vertical Anchor Cable

MTDC-805—Aft Track Segment, Otter

MTDC-806—Cessna 208 Plug Door

MTDC-807—Secondary Strut, Casa 212

MTDC-808—Cessna 208 Cable Anchor Points

MTDC-811—Cessna 208 Lexan Door

MTDC-812—Spotter Tether

MTDC-813—Paracushion Tether Harness

MTDC-816—Camera Mount, Cockpit, Otter

MTDC-821—Pull Test Tractor Weights Frame

MTDC-830—Fire Line Trencher

MTDC-833—Dornier 228 Vertical Anchor Cable

MTDC-834—Water Bag, 5 Gal.

MTDC-836—Second Secondary Strut, Casa 212

MTDC-838—Simulator Overhead Frame

MTDC-847—Simulator Associated Equipment

MTDC-855—Beech 99 Door Reinforcement

MTDC-857—Beech 99 Step Attachments

MTDC-869—Toggle Box, Simulator

MTDC-870—Dornier 228 Floor

MTDC-872—Dornier 228 Step Basket

MTDC-873—Dornier 228 Secondary Handrail

MTDC-874—Simula End Frame Modification

MTDC-881—C-23 Aft Cargo Bin

MTDC-884—Horizontal Anchor Assembly, Primary, DC-3

MTDC-885—Handrail and Communications Box Guard, Dc-3



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Videos

Smokejumper Pilot

Wenatchee Heights Burnover

Dude Fire Entrapment

Your Fire Shelter

Publications and drawings may be ordered in single copies. The videos and slide tape may be borrowed.

If you need additional information, contact:

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Current MTDC Projects

Project Leaders

SE02P08	Specifications & Standards	Bob Hensler (406) 329-3929
TE02P16	Tech Services-F&AM	Dick Mangan (406) 329-3849
TE02P16	Rappel Harness	George Jackson (406) 329-3967
TE02P16	Single Unit Headlamp	Dave Gasvoda (406) 329-3986
TE02P16	Potable & Nonpotable Water Bladders	George Jackson (406) 329-3967
TE02P16	Wildland Firefighter Protective Clothing	Ted Putnam (406) 329-3965
TE02P17	Tech Services- Smoke Jumper (Aircraft Evaluation)	Dave Pierce (406) 329-3927
0E02P28	Firefighters' Personal Tent	Ted Putnam (406) 329-3965
0E02P30	Smoke Respirators	Brian Sharkey (406) 329-3989
1E12P77	Dozer/Plow Safety	Jerry Jeffries (406) 329-3900
1E12P80	Ground Ignition	Jim Tour (406) 329-3923
1E12P94	Smokejumper Helmet	Dave Pierce (406) 329-3927
2E22P38	Flail Trencher	Keith Windell (406) 329-3956
3E22P40	Smokejumper Aircraft Accessories	Dave Pierce (406) 329-3927
2E22P85	Fire Tool Ergonomics	Diane Herzberg (406) 329-3957
4E42P14	Aerial Ignition	Jim Tour (406) 329-3923
4E42P14	Fire Shelter Improvements	Ted Putnam (406) 329-3965
8E82P11	Smokejumper Training Materials	Dave Pierce (406) 329-3927
9E92P13	Health Hazards of Smoke	Brian Sharkey (406) 329-3989
0E92P29	Face and Neck Protection	Ted Putnam (406) 329-3965
TE02P24	Chainsaw Chaps	Ted Putnam (406) 329-3965
0E02P27	Ram-Air Parachute Evaluation	Dave Pierce (406) 329-3927
1E12P79	Load Carrying Systems	Bill Kilroy (406) 329-39225
2E22P84	Low Impact Fire Plows	Diane Herzberg (406) 329-3957

Current SDTDC Projects

Project Leaders

TE01P11	Tech Services, Fire Management	Paul Hill
TE01P27	Tech Services, Fire Prevention	Lois Sicking
TE01P22	Tech Services, Fire Chemicals	Fred Cammack
5E43P20	Foam Application	Dan McKenzie
SE01P13	F&AM Specs & Standards	Lois Sicking
SE01P42	F&AM Qualification Program	
	Water Handling/Spark Arresters	Lois Sicking
	Fire Chemicals	Fred Cammack
1E01P44	MSE Spark Arr. Lab Upgrade	Fred Cammack
1E01P45	Prevention Videos	Ted Zrelak
3E31P66	NWCG Guides	Steve Raybould
TE01P12	Tech Services, Aviation	Rob Harrison
1E11P83	Helicopter Accessories	Kathy Kreyns
9E81A36	WACOS	Bill Makel
1E01P48	Helicopter Safety Trng Matls.	Steve Raybould
2E11P49	Hearing Safety & Helibases	Bill Makel
0E11A40	Noise Control	Bill Makel

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